1 Motivation

Feature learning demands discrimination which is in some major way endowed by the loss function design. Additive Angular Margin Loss (Arcface) is so proposed to incorporate intra-class compactness and inter-class discrepancy, the footnotes for discrimination. This paper claims that arcface constantly outperforms SOTA on large databases.

2 Loss and Geodesic Distance Constraints

Geodesic Distance/Metric d are embedded in loss functions.

- Margin Loss $d(\mathbf{x_1}, \mathbf{center_1}) + m < d(\mathbf{x_1}, \mathbf{center_2})$
- Intra Loss $d(\mathbf{x_1}, \mathbf{center_1}) \searrow$
- Inter Loss $d(\mathbf{center_1}, \mathbf{center_2}) \nwarrow$
- Triplet Loss $d(\mathbf{x_{11}}, \mathbf{x_{12}}) + m < d(\mathbf{x_{1i}}, \mathbf{x_2}), i = 1, 2$

This paper picks the margin loss.

3 Face Recognition

Two main line:

- To learn a multiclass classifier.
- To learn a "new" embedding (identify new person, clustering).

4 SOTA problems

- High complexity of softmax & Triplet loss.
- Triplet loss performs unsatisfactory in open-set (clustering)

5 Inductions

softmax loss:

$$L_1 = -\frac{1}{N}\sum_{i=1}^{N}\log\frac{\exp\left(W_{y_i}^T x_i + b_{y_i}\right)}{\sum_{j=1}^{n}\exp\left(W_j^T x_i + b_j\right)}$$

where (x_i, y_i) forms a pair of deep feature and ground truth of the i-th sample. W is the classification head's parameter.

This paper gives following modifications on the loss funcions

1 set $b_j = 0$

2 $W_j^T x_i = ||W_j||||x_i|| \cos\theta_j$

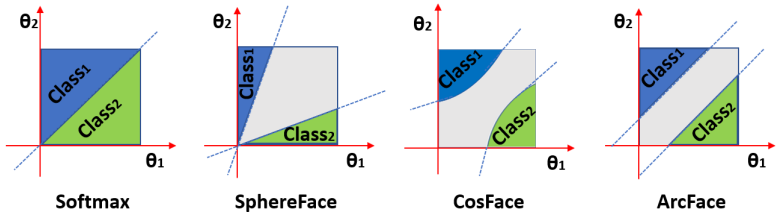
3 l_2-normalization on W_j, x_i, rescale x_i to s.

Thus

$$L_2 = -\frac{1}{N}\sum_{i=1}^{N}\log\frac{\exp\left(s\cos\theta_{y_i}\right)}{\exp\left(s\cos\theta_{y_i}\right) + \sum_{j=1,j\neq y_i}\exp\left(s\cos\theta_j\right)}.$$

And

$$L_4 = -\frac{1}{N}\sum_{i=1}^{N}\log\frac{e^{s(\cos(m_1\theta_{y_i}+m_2)-m_3)}}{e^{s(\cos(m_1\theta_{y_i}+m_2)-m_3)} + \sum_{j=1,j\neq y_i}\exp\left(s\cos\theta_j\right)}$$



Loss comparison of many different losses. Arcface has a good geometric intepretation. ($m_1 = 1, m_2 = 0.5, m_3 = 0$).

References

Deng, Jiankang, Jia Guo, and Stefanos Zafeiriou (2018). "ArcFace: Additive Angular Margin Loss for Deep Face Recognition". In: *CoRR* abs/1801.07698. arXiv: 1801.07698. URL: http://arxiv.org/abs/1801.07698.